SFU OFFICE OF THE PROVOST AND VICE-PRESIDENT ACADEMIC

vpacad@sfu.ca
www.sfu.ca/vpacademic
TEL: 778.782.3925
FAX: 778.782.5876

8888 University Drive
Burnaby, BC
Canada V5A 1S6

MEMORANDUM

ATTENTION	Senate	**DATE**	December 6, 2023
FROM	Dilson Rassier, Provost and Vice-President Academic and Chair, SCUP	**PAGES**	1
RE:	External Review Report for the Department of Mathematics (SCUP 23-47)		

At its meeting on December 6, 2023, SCUP reviewed the External Review Report for the Department of Mathematics that resulted from its External Review.

The Educational Goals Assessment Plan was reviewed and is attached for the information of Senate.

Motion: That Senate approve the Action Plan for the Department of Mathematics that resulted from its external review.

C: Manfred Trummer
Cedric Chauve

SFU OFFICE OF THE PROVOST
AND VICE-PRESIDENT ACADEMIC

8888 University Drive, Burnaby, BC
Strand Hall, Room 3000
Canada V5A 1S6

TEL: 778.782.5731
FAX: 778.782.5876

vpacad@sfu.ca
www.sfu.ca/vpacademic

MEMORANDUM

ATTENTION Dilson Rassier, Chair of SCUP
DATE October 18, 2023
FROM Peter Hall, Vice-Provost and Associate Vice-President, Academic
PAGES
RE: External Review of the Department of Mathematics

Attached are the External Review Report and the Action Plan for the Department of Mathematics. The Educational Goals Assessment Plan is included, for information only, with the Action Plan.

Excerpt from the External Review Report:
"We were pleased to see a very dedicated and engaged group of faculty, staff and students who care deeply about their colleagues, the Department, and its environment." Particular mention was made about "the ability to attract and recruit talented and enthusiastic graduate students in a challenging financial environment…, they have made excellent hires in recent years…," and that "the Department has also been successful in winning access to other Research Chairs through internal competitions."

Following the site visit, the Report of the External Review Committee* for the Department of Mathematics was submitted in April 2023. The reviewers made a number of recommendations based on the Terms of Reference that were provided to them. Subsequently, a meeting was held with the dean of the Faculty of Science, the chair of the Department of Mathematics, and the director of Academic Planning and Quality Assurance (Provost's Office) to consider the recommendations. An Action Plan was prepared taking into consideration the discussion at the meeting and the contents of the External Review Report. The Action Plan has been endorsed by the department and the dean.

Motion:

That SCUP approve and recommend to Senate the Action Plan for the Department of Mathematics that resulted from its external review.

*External Review Committee:
Anita Layton, University of Waterloo (Chair of External Review Committee)
Troy Day, Queen's University
Rachel Kuske, Georgia Institute of Technology
Tom Loughin (internal), Simon Fraser University

Attachments:
1. External Review Report (April 2023)
2. Department of Mathematics Action Plan
3. Department's Response to the External Review Report
4. Department of Mathematics Educational Goals Assessment Plan
5. Feedback on Educational Goals Assessment Plan
6. Department's Response to Feedback on Educational Goals Assessment Plan

cc Angela Brooks-Wilson, Dean, Faculty of Science
Manfred Trummer, Chair, Department of Mathematics

External Review Committee Report

The external review committee consists of Troy Day (Department of Mathematics and Statistics, Queen's University), Rachel Kuske (School of Mathematics, Georgia Institute of Technology), and Anita Layton (Department of Applied Mathematics, University of Waterloo). Together with the internal committee member Tom Loughin (Statistics and Actuarial Science), we met with SFU senior administration and the Department of Mathematics' (hereafter referred to as "the Department") Chair, faculty and staff, postdocs, graduate and undergraduate students, and selected other groups. Below is our assessment of the Department's strengths and weaknesses, and our recommendations that address major challenges and opportunities. We have addressed the issues raised in the External Review Committee Terms of Reference that are of specific interest to SFU and to the Department, as well as other issues that we consider notable.

1. Research

The Department has four active and vibrant research groups: Applied Mathematics, Discrete Mathematics, Number Theory / Algebraic Geometry, and Magpie. The research groups' ability to attract and recruit talented and enthusiastic graduate students in a challenging financial environment speaks to the strength of the Department's research activities. Another notable strength is that they have made excellent hires in recent years, albeit mostly within Magpie. In particular, the Canada 150 Chair hire of Colijn in 2018 has attracted a large amount of grant funding and substantially raised the research profile of the department. The Department has also been successful in winning access to other Research Chairs through internal competitions.

***Recommendation 1.1**: Develop short- and long-term vision for the department. Such a plan will naturally include a multi-year hiring plan that demonstrates clear connection to the stated priorities of the University and the Faculty.*

A general issue we noticed, in both our reading of the Department's Self-Study and in our meetings with various groups, is the absence of a clear articulation of the Department's aspiration.

As stated in its Self-Study (page 16), "the department sees research as its primary mission." As such, the Department should, in coordination with the Faculty of Science ("the Faculty") and SFU's Strategic Plan, develop a vision for the Department's research trajectory, an aspiration for its research profile and standing that takes into account the Department's strengths. Where does the Department want to be in five years and what are the concrete actions to be taken to get there? In ten years? The Department's current approach appears somewhat reactive to top-down hiring opportunities and, although it has been successful in that regard, a clear internal vision is also needed. Indeed, a vision should be developed for all Departmental activities including Teaching, Work environment, and EDI as well.

The realization of the aspiration and vision to be formulated by the Department will likely involve a multi-year hiring plan, but we encourage this plan to go beyond statements

like “More hires for group X”. As the Department develops that hiring plan, there must be a keen awareness of the Faculty and Institution priorities of building stronger connections across areas and disciplines, and to delivering programs in forward-looking research areas that lead to a broad range of productive careers. Hiring plans must also include both research and teaching faculty.

Access to hiring resources will depend on showing strong contributions to Institution and Faculty priorities, as well as the ability to flexibly take advantage of opportunities that arise. Proactive identification of potential recruits, particularly those that support diversity and other strategic initiatives, will increase the Department’s chances to hire at any level. The Faculty has indicated interest in hiring new faculty that can facilitate interdisciplinary research. The Department has been highly successful in Research Chair competitions and has the strengths to take advantage of this opportunity. Indeed, demonstrating multiple exciting options that reach beyond any internal subdiscipline will be necessary to return open positions to the Department.

We heard a number of different ideas for hiring that could be developed further into very attractive directions. There were common themes across probabilistic aspects of data science, optimization and discrete structures, all with connections to applications and to statistics, computing, and life sciences. As indicated above, an in-depth vision of the benefits of the hiring area that articulates the research impact, the potential talent that is available, and the strong interest from other departments where relevant, would provide for a more compelling argument in favour of such investments.

***Recommendation 1.2**: Develop mechanisms to promote faculty grant success.*

While a number of the research groups are strong, we note that the percentage of research faculty without an active NSERC grant (7, not counting a new faculty member, out of 36, ~20%) is noticeably higher than the overall Faculty percentage (~15%). Furthermore, our discussion with the AVP Research suggests that the Department’s involvement in institutional grant proposals has been limited.

The Faculty should work with the Office of the VPRI to develop bridge funding to help encourage and support faculty in securing external funding. For example, bridge funding might be provided centrally under the condition that faculty members who are supported in this way submit a grant application in the coming year. The Department should also develop mechanisms to encourage more proactive involvement in institutional grants and group grants (e.g., NSERC CREATE). Often, plans need to be in place before opportunities arise. One option to encourage proactive efforts is to provide teaching or service reduction. A further discussion of balancing workloads relative to research and supervision activity is continued below (see Section 5., Work Environment and EDI)

***Recommendation 1.3**: Promote a more vibrant research environment.*

Some faculty members have expressed the concern that the Department feels increasingly “sleepy.” For instance, attendance at some of the research seminars has dwindled. We also noticed that many of the graduate student offices are sparsely occupied, which suggests limited in-person interactions.

The importance of a vibrant Department full of research activities needs no explanation. To develop a Departmental culture of active participation, faculty members should encourage their graduate students to attend research seminars in their areas, and, of course, do so themselves. Students and postdocs, not faculty members, can be the ones to take the speakers out to lunch. That serves both as an opportunity for the trainees to network with senior scholars, and an encouragement for them to attend the seminars.

We propose a creative solution to solve both the problems of low seminar attendance and insufficient graduate student office space. Because, as we understand, the Department does not have enough space for every graduate student to have their own desk, conditions could be attached to desk assignments. To be assigned their own office space, a graduate student must agree to be on campus at least X days a week, and attend at least Y seminar every term (or some similar arrangement that the Department finds suitable and enforceable). Otherwise, desk space can be shared.

While we did not have much chance to talk with postdocs, nevertheless there might be upcoming opportunities to strengthen the research environment through postdoc integration and recruitment. With postdocs now moving under the VPRI umbrella, there may be opportunities to seek additional postdoc fellowships and/or larger grants for recruiting postdocs. Incorporating postdocs into the training mission of the department, e.g. through grad mentorships, leading informal journal clubs/topics seminars, ugrad research, etc and teaching courses under a reasonable workload, could help to fill training gaps while providing professional experience valuable for career skills. There are many good examples at peer institutions where postdocs provide vibrancy in the department in both research and teaching environments. Access to university employee support is also important.

We also spoke briefly to adjuncts, and themes of communication and continuity where possible were common in those conversations. Improving these aspects would support sustained contributions from those in adjunct positions.

2. Graduate Programs

Graduate students are essential talent to the research enterprise of the University, and their value must be reflected in their compensation. The graduate program of the Department offers degrees at the Master's and PhD levels in two primary areas: Mathematics and Applied and Computational Mathematics. In spite of some major systemic challenges, the department has continued its successful recruitment of graduate researchers.

Recommendation 2.1*: Substantially increase graduate students' take-home pay.*

This can be accomplished either by increasing the stipend, or reducing the students' obligated expenses.

At the University level, one potential solution, brought up by a number of constituents, is a tuition fee waiver. While this is attractive, at the end of the day such waivers are no different from the perspective of the university budget than simply increasing student

stipends. As a result, while tuition waivers are one possibility, other creative solutions might also be possible to increase the net standard of living of graduate students. That is likely outside of the scope of the Department or even the Faculty, but a concerted effort is likely needed to overcome any institutional resistance, given the implications on institutional revenue. The funding gap could come from grad application fees or university owned housing, but either way, the university needs to decide to make this a spending priority.

At the Departmental level, it is our understanding that when graduate students attempt to increase their income by taking on an additional TA (BU) or some other source, supervisors are allowed to reduce their research funding. While graduate students are supported via TAships and RAships and expected to work full time, we should recognize the reality that they aren't being paid a living wage. Department policy should stipulate that when graduate students take on a reasonable amount of extra work that does not significantly impact the progress of their research, supervisors cannot reduce their stipend contributions.

It is clear to us and to most members of the University that the graduate student stipend issue is an urgent one. Actions must be taken immediately.

***Recommendation 2.2**: Take advantage of various efficiencies and existing programs to address grad student course and career training needs. We have three specific suggestions.*

a) The Graduate Studies Committee noted that the mathematics background of some of the graduate students is rather weak, with inadequate grasp of basic topics such as (undergraduate level) linear algebra, ODEs, PDEs, etc. There is consideration of developing half-credit graduate courses to teach these undergraduate topics.

We suggest that the Department work with University administration to allow less prepared grad students to take advanced undergrad courses during their graduate degrees (see e.g. Institute for Applied Math at UBC program options). Developing new "background" courses at the graduate level is not a good use of Department resources. However, breaking some core grad courses up into smaller modular units or running certain boot camps using existing training resources might provide a better set of options for students in some cases. Furthermore, the additional teaching required can be fulfilled by postdocs, who might be well served by the training opportunity.

b) One question that was brought to us was: How best should we structure regular graduate course offerings to balance the needs of students with healthy enrollments in each course? Some of the graduate courses appear to have a healthy enrollment; some less so.

Faculty should consider updating and refocusing their graduate courses regularly to attract a large enough audience, or developing new courses to meet student interests/needs. If expertise can't be found within the Department, students should be encouraged to take advantage of the courses offered by PIMS and similar programs.

c) SFU has a Graduate Co-op program. That is great but the co-op term(s) count towards the students' time-of-completion. That is not so great, as it may reduce the time the student has for their thesis research, and might negatively impact those with scholarships. Supervisors should more actively encourage students to look into co-op and value the experience that co-op provides to their trainees.Pointing out to graduate students that there exist industry jobs in the abstract is not enough. It is our responsibility to *prepare* some of our graduate students, pure and applied alike, for a career in industry.

***Recommendation 2.3**: Improve training of graduate students as teachers of mathematics, and increase their opportunities for this type of experience.*

One issue that we noted is that opportunities for graduate students to teach courses are relatively limited due to constraints imposed by various collective agreements. A concerted effort should be made during collective bargaining for the university and the relevant unions to reach a mutually satisfactory agreement on how the training of graduate students in teaching can be achieved. There are several comparator institutions that have managed to negotiate appropriate and workable agreements.

Excellent teacher training will benefit the graduate students, whether they pursue a career in academia or industry. For the latter, we believe the Department can significantly improve its graduate students' preparation.

Another issue that we have noted is the lack of formal mentoring programs, and people who engage in mentoring activity do not get recognition for this important service. We have heard from graduate students that they have to resort to teaching each other how to use Canvas and other tools.

We were informed that substantial investment in grad level teaching training was done some years ago, including SVSPO training. With updates in technology and other teaching responsibilities, efforts should be made to ensure grad students are getting the on-boarding that is needed, so that they are not left to have to do the catching up themselves. Appropriate workload credit is also needed for leading on-boarding activities.

The Department should find out from instructors and TA's what they need to learn, and provide proper training. Any existing training seems to miss some key facets of their jobs. Mentors in these programs should be compensated as appropriate.

***Recommendation 2.4**: Improve communication with graduate students.*

Communication was brought to us as an area that needs improvement. Some graduate students are left in the dark until the last minute regarding how many BU and how much research-related funding they will have for a given term. The late notification makes planning difficult. (See also comments above under graduate salaries and clarity about the (non)-reduction of stipends.)

Graduate students should be told what their supervisors have requested for them, in terms of teaching and funding, for the upcoming year, with the understanding that the

request is contingent upon Faculty approval. This information can be incorporated into the grad progress report. There is an “Anticipated financial support for next year” box, where more term-by-term details can be stipulated.

Related topics raised by the graduate students included providing consistency, fairness, and transparency in other areas, including comprehensive exams, workload, and TA expectations. We encourage the department to engage in discussions on these topics, perhaps also consulting peers on their approaches for addressing the needs of today’s graduate students.

3. Undergraduate Teaching

Over the last several years the department has done an admirable job in navigating through the complexities of the pandemic, and even more substantially, the large increase in the number of students taking math courses. This has been in an environment of changing admissions and non-uniformity in high school standards, The department has innovated in a variety of ways to deal with logistical challenges, while working to focus to educational standards - e.g. efficient use of “mixers” to increase workshop/tutorial traffic, ID scanners for exams, options for joint majors, white board seminars as part of pedagogy, updates of Math for Life Sciences curriculum, etc. Teaching and engagement of students is a high priority in the department.

At the same time there are critical structural challenges given the severe increases in student demands and lack of support for activities at the Surrey campus. Support of the Department to meet these challenges will be of great benefit to the students and the University overall.

Recommendation 3.1*: Change the structure of large first-year offerings*.

A number of people that we talked to have noted that the model of large lecture sections in service courses, supported by drop-in workshops, is no longer viable. Changes in provincial standards have created significant problems in first year courses. Students have difficulty transitioning from high school; this problem seems to have been exacerbated by COVID. With increasingly poor student preparation, teaching faculty’s workload has skyrocketed. Some instructors are recording lectures and using the classroom as practice and clarification time, but it is not clear that this is improving learning, nor is it a sensible solution for large classes. Leaving things as they currently stand will necessarily result in one of two undesirable outcomes: a high failure rate for students or a low competency level in students who pass. Staff also feel very overworked and the staff to AFTE ratio appears to be low compared to other units. (see also Section 4.)

The needs of undergrads with diverse backgrounds, becoming more acute with changes in provincial educational practices, require a number of changes in delivery of entry level courses.

- Placement exams can be used to stream students into appropriate courses, (e.g. foundational pre-calc courses (FAN) vs. calculus stream). See e.g. UBC placement exam system or other peer institutions.

- Required tutorials rather than optional workshops can be used to foster student learning and study skills.

Changes in these directions provides the opportunity to rethink the deployment of math TA's, who can be concentrated on the calculus stream, complemented with hiring undergraduate TA's and TA's from outside of math to support (FAN). The current "Calculus Connect" peer-learning program may be expanded. The Faculty and the Provost's Office should work with the Department to realize these steps, critical in support of the diverse student population and retention. It cannot be overemphasized that adequate resources to staff large service courses are critical. These courses are significant sources of revenue for the Faculty and need to be staffed accordingly. See also staff support for comments on administrative support for these programs (e.g. for educational IT and coordination support).

***Recommendation 3.2**: Update the computing requirements and integrate computing throughout course offerings.*

A research strength of the Department is computing, and this is also incorporated into the undergraduate curriculum. However, the current computing requirements were developed a long time ago. At present there are two Math programming language courses taught with a focus on Matlab and Maple, not the more popular language Python.

Many peer institutions have updated their curriculum as follows: ensuring programming literacy to be covered through a basic programming course in CS-type departments, with further computational experiential learning integrated directly in math courses through sample code and assignments in platforms appropriate to the subject - e.g. linear algebra exercises in Matlab, R programming in probability/stats, symbolic computation in other areas, others for DE's, etc. This will require some updating of the courses. Minimal support through hiring of graduate or undergraduate TA's in summer would help to accelerate this modernization. *We emphasize that the undergrads we spoke to enthusiastically recommended (without any prompting from us) this modernization, which also included removing the existing platform-centric courses offered by the department and instead integrating computational techniques directly in courses. Further discussions with your math majors and undergrads would likely reveal other good ideas. They also had very practical recommendations about timing, accessibility, and alignment of various pre-reqs that have been barriers for getting to course sequences of interest*

***Recommendation 3.3**: Increase both the visibility and possible pathways to research and co-op type activities.*

The undergrads also indicated interest for increased opportunities in research and co-op type activities. In the present setting, there was little visibility or pathways provided by the department/instructors/advisors for either of these activities: This could be improved by Advertising opportunities for USRA's or for co-op type experiences with the assistance of appropriate SFU offices. Modernizing courses to be relevant for

co-ops will also be helpful - e.g. opportunities for projects that are valuable for applications.

***Recommendation 3.4**: Develop a long-term strategy for Surrey.*

The Surrey campus was noted as an issue in the last review, and remains one this time. There may be two issues: one with the OR program that is run from Surrey, but for which most non-OR courses are taught in Burnaby; and the other with supporting the service teaching that takes place on the Surrey campus. Multiple faculty members brought up problems, including insufficient continuing instructors and TA support. Sessional instructors are often hired, but there are concerns that they may not be able to develop the connections with students needed to advise them or to write recommendation letters. Also, most graduate students are not willing to commute to Surrey. They hold remote office hours, but that means there aren't enough local TA's to help proctor exams.

The Department and Faculty must decide whether they want to properly resource the Surrey courses, or just shut it down. The current approach of starving it does no one any good, long or short term. A potential approach is to hire a "pod" of teaching faculty to address the Surrey service courses, complementing the two that are already there. We emphasize that requiring some of the current teaching faculty to teach on both campuses is not a workable solution. We understand that the Surrey campus now offers 21 courses with a total enrollment of approximately 2,000 students. If there are worries about losing the 2,000 students, perhaps online courses can be an option albeit admittedly non-ideal.

4. Administrative staff

The administrative staff that we met seem very capable and dedicated. The staff works as an amazing team, having an excellent rapport with each other and the department as a whole. Such a team is extremely valuable. They are eager to take leadership on needed activities, if given the support and time to do so.

However, a number of the staff expressed frustrations that they are overworked and not adequately appreciated and supported. They are also discouraged by the lack of attention or willingness to improve their work environment (e.g., poor temperature regulation in some admin offices). There also appears to be limited opportunity for professional development for staff members.

***Recommendation 4.1**: Ensure appropriate workload and compensation.*

The department should better understand and recognize what each staff member has been doing. How much of that is outside of their job description? Some of the staff's job description may warrant a substantial update, and those roles subsequently upgraded. Ultimately, additional positions are likely needed because the Department seems to be understaffed and under-resourced relative to other units in the Faculty. What the staff see as critically needed is a new position with a portfolio that includes communications, event coordination, and alumni outreach. Alumni outreach seems to be relatively limited at the moment and there are fantastic opportunities to engage in outreach through

high-profile activities like those of the Magpie group. Such outreach could also result in valuable contacts with industry.

Properly adjusting staff workload and compensation is important, because otherwise the department will need to prepare for many staff departures. Without good support staff, one cannot talk about providing a high-level of teaching or research. Department chair must follow up, and the Faculty Dean should ensure that administrators at the Faculty level support the Department in these requests. While beyond the scope of this review, the lack of attention to staff was reported to permeate throughout the entire University. It appeared that promoting professional development, career progress, and recognition for staff would go a long way in strengthening to overall environment

We also received data on the FTE support personnel in the Faculty, by department, together with the AFTE counts. The FTE support numbers in Math appeared remarkably low relative to their AFTE load. While it appears that some of the FTE support in other departments may be related to wet labs, nevertheless it appears that the scale of teaching labs in Math in the form of workshops and tutorials has not been supported at the same level, not to mention the sheer scale of administrative support needed to advise, instruct, and assess the students within Math's AFTE load. We urge the Faculty to assess and address these gaps in collaboration with the department.

***Recommendation 4.2**: Provide professional development opportunities.*

Substantially increase the attention to the importance of staff and their contributions. Support via professional development is needed at all levels of administration. Give time off and funding support for staff to participate in professional development training. Ensure clear guidelines for their job responsibilities, including both what is and what is not part of their workloads.

5. Work environment, EDI

We were pleased to see a very dedicated and engaged group of faculty, staff and students who care deeply about their colleagues, the Department, and its environment. The upcoming environment review by an external firm is also a step towards identifying future positive actions, and we encourage the department and Faculty to fully engage in that activity. That said, we note a number of workload issues that need to be considered in addressing workload balance throughout the department, with appropriate response measures formalized and made transparent.

***Recommendation 5.1**: Address a number of workplace issues, as follows:*

- As noted above, many of the staff appear to be overworked.
- Also as previously noted, 20% of the math research faculty don't have an active grant. With no funding are they still mentoring graduate students? Is their teaching load the same as active research faculty? Are they taking on a larger administrative role?

- Teaching a small class or a large lecture with 500 students results in the same, one course, teaching credit.
- Teaching faculty can receive teaching reduction beyond going from 8 to 6 (i.e., going below 6) via additional initiatives. But what counts and how those additional teaching reductions are distributed isn't transparent to many members.
- Does merit review reflect important strategic contributions: for example but not limited to expansion of cross-disciplinary programs, pursuing new research funding avenues, major curriculum reform, other alignment with Institution/Faculty priorities
- Are the merit assessment criteria clear to all parties and followed?

***Recommendation 5.2**: Provide resources to support EDI initiatives.*

We met with the EDI advisory group and the EDI learning group. One issue that stands out to us is that EDI groups aren't adequately supported in their activities. Staff contributions are considered uncompensated volunteer work.

***Recommendation 5.3**: Ensure effective Faculty and Departmental EDI leadership.*

Department and Faculty leadership should demonstrate true support of EDI initiatives by providing resources and by their own in-person participation. EDI committee membership should have the confidence of department members who they represent.

Also, the fact that there is an EDI advisory group and an EDI learning group is odd, and is perhaps a symptom of underlying issues.

Consider having the EDI advisory group led by two co-chairs. Leadership should have the support and buy-in of the faculty members. Perhaps then both EDI groups can be combined.

To improve the atmosphere in the department would require department leadership (possibly via an external hire) that is sufficiently free of baggage and capable of mending relations among faculty members. An excellent first step would be department-wide support of the EDI committee's ToR and their goals of facilitating integration of EDI goals in all department processes. Support from Faculty and University expertise should be sought regularly in realizing these goals. Success and expertise at peer institutions provide many good examples which can be adapted. Take the upcoming external environmental review seriously, and work with them to get the most out of their interactions from the department.

Active involvement at both the institution and Faculty levels will also be essential for success. As new strategic plans are put into place, EDI must be articulated as a necessary ingredient in excellence throughout all programs, not as an "add-on" at the end. Concrete actions that demonstrate this should appear at all levels.

The Faculty should commit to working actively with all departments to ensure visible and robust EDI processes that are embedded in recruitment, retention, and realizing an inclusive workplace.

EXTERNAL REVIEW – ACTION PLAN

Section 1 – To be completed by the Responsible Unit Person, e.g., Chair or Director

Unit under review	Date of Review Site visit	Responsible Unit person	Faculty Dean
……**Mathematics**……	…March 22-24, 2023……	……Manfred Trummer……	**…Dr Angela Brooks-Wilson…**

Notes

1. *It is **not** expected that every recommendation made by the External Review Committee be covered by this Action Plan. The major thrusts of the report should be identified and some consolidation of the recommendations may be possible while other recommendations of lesser importance may be excluded.*
2. *Attach the required plan to assess the success of the **Educational Goals** as a separate document (Senate 2013).*
3. *Should any additional response be warranted, it should be attached as a separate document.*

1. PROGRAMMING

1.1 Action/s (description what is going to be done):

1.1.1 Undergraduate:

- **Investigate ways to improve our large service course offerings. Switching to a model with many small sections (say 40 students) might be more engaging for our students, but such a change would have significant resource and logistical implications. We will continue to evaluate possible improvements on how we organize and operate workshops.**
- **The role of computing in our undergraduate courses will be expanded, and we will include computational content that does not rely on proprietary software.**
- **We will continue to promote our "Calculus Connect" peer mentoring program.**
- **We will articulate a plan for the future of our presence in Surrey that will likely rely more on teaching faculty.**

1.1.2 Graduate:

- **We had raised the issue about how to best prepare our incoming graduate students for success. Currently many graduate courses start with refreshers on various background material; we plan to offer one preparation course each fall where we teach this material as well as general research skills.**
- **Increase opportunities for graduate students to get teaching experience.**
- **Carry out consultations with the aim of fulfilling a recommendation from the 2014 External Review Report: "*We recommend the geographic unification of the graduate students' offices.*"**
- **Improve communication processes for graduate students.**

1.2 Resource implications (if any):

If we were to switch to a model of small-section service courses, resource implications would be significant. Reorganizing our current system may require expanding operational support for workshops, so likely a half-time (or possibly more) support staff position.
Any solution for graduate student spaces closer to the department's main location will likely require some funds for renovation and furniture.

1.3 Expected completion date/s:

September 2025 for all initiatives.

2. RESEARCH

2.1 Action/s (what is going to be done):

- **Articulate a short- and long-term vision for the department based on the existing hiring plan, while maintaining flexibility to take advantage of strategic opportunities.**
- **Promote vibrant research environment.**

2.2 Resource implications (if any):

Time commitment by faculty members.

2.3 Expected completion date/s:

These items require thoughtful discussion. This should involve the new Chair who will start no later than January 2024. Completion by June 2024.

3. ADMINISTRATION

3.1 Action/s (what is going to be done):

- **We will ask for the creation of a new support position of Academic Coordinator. This role will ensure efficient delivery of our programs and increase student satisfaction and retention. A detailed position description will be drafted.**
- **When such a position is created, job descriptions of all our support staff will be updated and some responsibilities will be reassigned. The department would also like to have some capacity for alumni engagement, and with an additional administrative support position this could be achieved.**

3.2 Resource implications (if any):

A full-time APSA position.

3.3 Expected completion date/s:

December 2023.

4. WORKING ENVIRONMENT

4.1 Action/s (what is going to be done):

- **Finalize and approve terms of reference for the Mathematics Department EDI Advisory Group.**
- **Update departmental equivalencies for "research-active" faculty members.**

4.2 Resource implications (if any):

Time commitment from faculty members.

4.3 Expected completion date/s:

April 2024

5. ..... (*OTHER*)

5.1 Action/s:

5.2 Resource implications (if any):

5.3 Expected completion date/s:

The above action plan has been considered by the Unit under review and has been discussed and agreed to by the Dean.

Unit Leader (signed)	**Date**
Manfred Trummer Digitally signed by Manfred Trummer Date: 2023.10.16 16:24:07 -07'00' **Name** Manfred Trummer **Title** Professor & Chair	10/16/23

Section 2 - Dean's comments and endorsement of the Action Plan:

The Department of Mathematics has done a very good job of responding to the External Review and developing an Action Plan that will be helpful for the department over the next few years. I comment here mainly on items from the Action Plan that have resource implications or broader implications for the Faculty of Science.

1. Programming

1.1.1 Undergraduate:

I appreciate the care the MATH department devotes to large classes. While it is not possible to move to small classes, I endorse efforts to provide improvements to how MATH organizes and operates workshops. I support the addition of a half-time support staff position to ensure optimal operations in support of large classes, to augment the efficiency of teaching.

Planning for Surrey should involve talking with other departments, as a collaborative effort to promote a collegial environment for faculty in Surrey would be helpful across the Faculty of Science and beyond.

1.1.2 Graduate:

If graduate student spaces are moved, it is feasible to obtain any needed furniture. Renovations should be avoided if at all possible.

2. Research

I encourage the thoughtful discussion and development of a vision for research and research hires in MATH. I encourage the department to identify a small number of current or clearly emerging research strengths.

3. Administration

It has become clear recently that staff levels in the MATH department are critically low. I am supportive of the addition of an academic coordinator to ensure the effective delivery of programs.

4. Working Environment

MATH has devoted considerable attention to EDI and work environment over the last year. EDI is important for the MATH department and I am glad to see the intent to finalize a departmental EDI Advisory Group. This group should plan to work harmoniously with the Faculty of Science Associate Dean for EDI.

I have appreciated working with Dr. Trummer and will also look forward to working with the new Chair in 2024.

Faculty Dean  Digitally signed by Angela Brooks-Wilson Date: 2023.10.17 08:30:14 -07'00'	**Date** 10/17/23
.....	.....

Mathematics Department Response to the External Review Committee Report

Version Date: 2023 September 18

Original ECR Report is in green and ECR's recommendations are in blue font.

We thank the reviewers for their commitment of time and energy, for sharing their observations and for providing thoughtful suggestions.

The external review committee consists of Troy Day (Department of Mathematics and Statistics, Queen's University), Rachel Kuske (School of Mathematics, Georgia Institute of Technology), and Anita Layton (Department of Applied Mathematics, University of Waterloo). Together with the internal committee member Tom Loughin (Statistics and Actuarial Science), we met with SFU senior administration and the Department of Mathematics' (hereafter referred to as "the Department") Chair, faculty and staff, postdocs, graduate and undergraduate students, and selected other groups. Below is our assessment of the Department's strengths and weaknesses, and our recommendations that address major challenges and opportunities. We have addressed the issues raised in the External Review Committee Terms of Reference that are of specific interest to SFU and to the Department, as well as other issues that we consider notable.

1. Research

The Department has four active and vibrant research groups: Applied Mathematics, Discrete Mathematics, Number Theory / Algebraic Geometry, and Magpie. The research groups' ability to attract and recruit talented and enthusiastic graduate students in a challenging financial environment speaks to the strength of the Department's research activities. Another notable strength is that they have made excellent hires in recent years, albeit mostly within Magpie. In particular, the Canada 150 Chair hire of Colijn in 2018 has attracted a large amount of grant funding and substantially raised the research profile of the department. The Department has also been successful in winning access to other Research Chairs through internal competitions.

While we agree that our recent hires in the Magpie group are excellent, we were surprised that the Algebraic Geometry and Quantum Computing hires appear to have been ignored.

***Recommendation 1.1**: Develop short- and long-term vision for the department. Such a plan will naturally include a multi-year hiring plan that demonstrates clear connection to the stated priorities of the University and the Faculty.*

A general issue we noticed, in both our reading of the Department's Self-Study and in our meetings with various groups, is the absence of a clear articulation of the Department's aspiration.

As stated in its Self-Study (page 16), "the department sees research as its primary mission." As such, the Department should, in coordination with the Faculty of Science ("the Faculty")

and SFU's Strategic Plan, develop a vision for the Department's research trajectory, an aspiration for its research profile and standing that takes into account the Department's strengths. Where does the Department want to be in five years and what are the concrete actions to be taken to get there? In ten years? The Department's current approach appears somewhat reactive to top-down hiring opportunities and, although it has been successful in that regard, a clear internal vision is also needed.
Indeed, a vision should be developed for all Departmental activities including Teaching, Work environment, and EDI as well.

The realization of the aspiration and vision to be formulated by the Department will likely involve a multi-year hiring plan, but we encourage this plan to go beyond statements like like "More hires for group X". As the Department develops that hiring plan, there must be a keen awareness of the Faculty and Institution priorities of building stronger connections across areas and disciplines, and to delivering programs in forward-looking research areas that lead to a broad range of productive careers. Hiring plans must also include both research and teaching faculty.

Access to hiring resources will depend on showing strong contributions to Institution and Faculty priorities, as well as the ability to flexibly take advantage of opportunities that arise. Proactive identification of potential recruits, particularly those that support diversity and other strategic initiatives, will increase the Department's chances to hire at any level. The Faculty has indicated interest in hiring new faculty that can facilitate interdisciplinary research. The Department has been highly successful in Research Chair competitions and has the strengths to take advantage of this opportunity. Indeed, demonstrating multiple exciting options that reach beyond any internal subdiscipline will be necessary to return open positions to the Department.

We heard a number of different ideas for hiring that could be developed further into very attractive directions. There were common themes across probabilistic aspects of data science, optimization and discrete structures, all with connections to applications and to statistics, computing, and life sciences. As indicated above, an in-depth vision of the benefits of the hiring area that articulates the research impact, the potential talent that is available, and the strong interest from other departments where relevant, would provide for a more compelling argument in favour of such investments.

This is a good observation and suggestion. The department has an updated 3-year hiring plan in which synergy with other departments' research strengths are emphasized. We will expand this to a longer-term plan that includes the research activities of the department as well as other activities. Past experience, however, has been that actual developments rarely follow any previously laid out long-term plans. In fact, one could argue that a strength of our department has been its flexibility to respond to strategic opportunities as evidenced by the hirings in the MAGPIE group and in Quantum Computing.

Recommendation 1.2*: Develop mechanisms to promote faculty grant success.*

While a number of the research groups are strong, we note that the percentage of research faculty without an active NSERC grant (7, not counting a new faculty member, out of 36, ~20%) is noticeably higher than the overall Faculty percentage (~15%).
Furthermore, our discussion with the AVP Research suggests that the Department's involvement in institutional grant proposals has been limited.

The Faculty should work with the Office of the VPRI to develop bridge funding to help encourage and support faculty in securing external funding. For example, bridge funding might be provided centrally under the condition that faculty members who are supported in this way submit a grant application in the coming year. The Department should also develop mechanisms to encourage more proactive involvement in institutional grants and group grants (e.g., NSERC CREATE). Often, plans need to be in place before opportunities arise. One option to encourage proactive efforts is to provide teaching or service reduction. A further discussion of balancing workloads relative to research and supervision activity is continued below (see Section 5., Work Environment and EDI).

The number of faculty members without grant support (in Math mostly NSERC Discovery grants) is in line with the average in the Faculty of Science; the figures cited by the ERC are inaccurate. The 2023 Funding Report by the Science Grants Facilitators from March 2023 showed that 7 Math faculty had no DG, reflecting 81% hold a DG. The same summary showed the Faculty of Science data for comparison, as 79.5% holding a DG (based on data available for 200 of the 204 Science researchers). As of April 2023, 30 out of 36 faculty members (83.3%) hold NSERC grants; one of our research faculty members is under the SSHRC umbrella.

We do, of course, aspire to a higher success rate, and have in place mentoring initiatives. Faculty members are encouraged to apply and to work with our Faculty of Science grants facilitators to improve their proposals. The office of the VPR used to provide one-year bridge funding to people who lost their grant, but this appears no longer available. The department does assist faculty with graduate student support if they lose their NSERC grants, and we encourage and maintain a healthy culture of co-supervision -- both to keep faculty members' research program active and to maintain a good HQP record.

Point taken for the need to look for funding opportunities beyond just the NSERC Discovery Grants program. The department would certainly consider reduction in service or even teaching for any faculty member who wants to lead a major grant initiative. There have been some recent successes, for example, Bojan Mohar as one of the principal investigators in a large ERC grant.

***Recommendation 1.3**: Promote a more vibrant research environment.*

Some faculty members have expressed the concern that the Department feels increasingly "sleepy." For instance, attendance at some of the research seminars has dwindled. We also noticed that many of the graduate student offices are sparsely occupied, which suggests limited in-person interactions.

The level of activity is not the same in all research groups. The NTAG (Number Theory & Algebraic Geometry) group has a very well attended weekly seminar series, and "sleepy" would not be an apt word to describe their situation. Other groups also have regular seminars but could benefit from higher levels of participation. There are many (competing) opportunities to attend online

seminars; particularly, PIMS offers those on a regular basis.

The reviewers were shown some of the graduate student offices at 9am, and others at 5pm, occupancy was not at the level one would observe during the day.

We would also like to note that this year saw the long overdue reinstatement of a departmental colloquium series with four talks that drew a large audience from students and faculty across all research groups. This series will continue.

The importance of a vibrant Department full of research activities needs no explanation. To develop a Departmental culture of active participation, faculty members should encourage their graduate students to attend research seminars in their areas, and, of course, do so themselves. Students and postdocs, not faculty members, can be the ones to take the speakers out to lunch. That serves both as an opportunity for the trainees to network with senior scholars, and an encouragement for them to attend the seminars.

We believe the far greater challenge for maintaining a vibrant atmosphere is the geographic spread of the department across the Burnaby Campus (let alone the remoteness of our Surrey group), and the lack of a dedicated department lounge found at many other Universities. Having faculty, graduate students and postdocs and visitors closer together would facilitate important research, teaching and social interactions. The department is looking to improve the situation within its space constraints.

We propose a creative solution to solve both the problems of low seminar attendance and insufficient graduate student office space. Because, as we understand, the Department does not have enough space for every graduate student to have their own desk, conditions could be attached to desk assignments. To be assigned their own office space, a graduate student must agree to be on campus at least X days a week, and attend at least Y seminar every term (or some similar arrangement that the Department finds suitable and enforceable). Otherwise, desk space can be shared.

An interesting suggestion. We foresee some problems with record keeping and tracking, so it might be difficult to enforce. We will certainly investigate ways to incentivize seminar attendance possibly by assigning credit for it.

While we did not have much chance to talk with postdocs, nevertheless there might be upcoming opportunities to strengthen the research environment through postdoc integration and recruitment. With postdocs now moving under the VPRI umbrella, there may be opportunities to seek additional postdoc fellowships and/or larger grants for recruiting postdocs. Incorporating postdocs into the training mission of the department, e.g. through grad mentorships, leading informal journal clubs/topics seminars, ugrad research, etc and teaching courses under a reasonable workload, could help to fill training gaps while providing professional experience valuable for career skills. There are many good examples at peer institutions where postdocs provide vibrancy in the department in both research and teaching environments. Access to university employee support is also important.

We are happy to explore ways to integrate postdocs more into departmental activities. Generally, postdocs are not being directly funded by the department, so it will require getting supervisors on board. Implementing the suggestion would be useful for postdoc training and will improve academic career chances.

We also spoke briefly to adjuncts, and themes of communication and continuity where possible were common in those conversations. Improving these aspects would support sustained contributions from those in adjunct positions.

2. Graduate Programs

Graduate students are essential talent to the research enterprise of the University, and their value must be reflected in their compensation. The graduate program of the Department offers degrees at the Master's and PhD levels in two primary areas: Mathematics and Applied and Computational Mathematics. In spite of some major systemic challenges, the department has continued its successful recruitment of graduate researchers.

***Recommendation 2.1**: Substantially increase graduate students' take-home pay.*

This can be accomplished either by increasing the stipend, or reducing the students' obligated expenses.

At the University level, one potential solution, brought up by a number of constituents, is a tuition fee waiver. While this is attractive, at the end of the day such waivers are no different from the perspective of the university budget than simply increasing student stipends. As a result, while tuition waivers are one possibility, other creative solutions might also be possible to increase the net standard of living of graduate students. That is likely outside of the scope of the Department or even the Faculty, but a concerted effort is likely needed to overcome any institutional resistance, given the implications on institutional revenue. The funding gap could come from grad application fees or university owned housing, but either way, the university needs to decide to make this a spending priority.

We agree with the need for better funding of graduate students. (i) our members have been active in articulating the need for increased funding from the university, (ii) the university's recent announcement of funding for PhD students is a promising first step towards improving graduate student funding, (iii) we are continuing to advocate for long-term solutions.

At the Departmental level, it is our understanding that when graduate students attempt to increase their income by taking on an additional TA (BU) or some other source, supervisors are allowed to reduce their research funding. While graduate students are supported via TAships and RAships and expected to work full time, we should recognize the reality that they aren't being paid a living wage. Department policy should stipulate that when graduate students take on a reasonable amount of extra work that does not significantly impact the progress of their research, supervisors cannot reduce their stipend contributions.

Our minimum funding levels are not negotiable. When supervisors accept a graduate student they commit to a certain level of RA funding, and fulfilling those commitments is department policy.

It is clear to us and to most members of the University that the graduate student stipend issue

is an urgent one. Actions must be taken immediately.

Recommendation 2.2: *Take advantage of various efficiencies and existing programs to address grad student course and career training needs. We have three specific suggestions.*

a) The Graduate Studies Committee noted that the mathematics background of some of the graduate students is rather weak, with inadequate grasp of basic topics such as (undergraduate level) linear algebra, ODEs, PDEs, etc. There is consideration of developing half-credit graduate courses to teach these undergraduate topics.

We suggest that the Department work with University administration to allow less prepared grad students to take advanced undergrad courses during their graduate degrees (see e.g. Institute for Applied Math at UBC program options). Developing new "background" courses at the graduate level is not a good use of Department resources. However, breaking some core grad courses up into smaller modular units or running certain boot camps using existing training resources might provide a better set of options for students in some cases. Furthermore, the additional teaching required can be fulfilled by postdocs, who might be well served by the training opportunity.

We will revisit these issues based on the recommendation. Our programs allow 700-level courses (cross-listed with 400-level undergraduate courses) to be taken for credit. Even expanding these options will not necessarily answer the need for better preparation. The goal of the "bootcamp" is to bring students up to speed on a variety of topics in a short period of time, which is not easily accomplished by just one or two regular (undergraduate) courses. We believe that such a course will improve our program and benefit our students, and we intend to pursue its implementation.

b) One question that was brought to us was: How best should we structure regular graduate course offerings to balance the needs of students with healthy enrollments in each course? Some of the graduate courses appear to have a healthy enrollment; some less so.

Faculty should consider updating and refocusing their graduate courses regularly to attract a large enough audience, or developing new courses to meet student interests/needs. If expertise can't be found within the Department, students should be encouraged to take advantage of the courses offered by PIMS and similar programs.

A good suggestion which we already follow. We offer many special topics courses (described in our self-study) that are courses on more recent topics trying to better serve our students. Students often take PIMS network courses or courses at UBC which are covered under the Western Deans' Agreement.

c) SFU has a Graduate Co-op program. That is great but the co-op term(s) count towards the students' time-of-completion. That is not so great, as it may reduce the time the student has for their thesis research, and might negatively impact those with scholarships. Supervisors should more actively encourage students to look into co-op and value the experience that co-op provides to their trainees. Pointing out to graduate students that there exist industry jobs in the abstract is not enough. It is our responsibility to *prepare* some of our graduate students, pure and applied alike, for a career in industry.

We will continue to make our students aware of Co-op opportunities; we do not believe, however, that lack of awareness is to blame for low uptake by students. The issue around completion times can be addressed by the University, but we feel that given the generous completion times that this issue is not a serious impediment. A few of our students have taken advantage of MITACS Internships. Many faculty members put in a great deal effort into helping our students find careers in industry; indeed, our self-study document points to the wide range of careers our alumni have gone on to.

***Recommendation 2.3**: Improve training of graduate students as teachers of mathematics, and increase their opportunities for this type of experience.*

One issue that we noted is that opportunities for graduate students to teach courses are relatively limited due to constraints imposed by various collective agreements. A concerted effort should be made during collective bargaining for the university and the relevant unions to reach a mutually satisfactory agreement on how the training of graduate students in teaching can be achieved. There are several comparator institutions that have managed to negotiate appropriate and workable agreements.

TSSU seniority rules have made it increasingly difficult to hire graduate students for teaching as we can only reserve a small percentage of our courses for our students.

Excellent teacher training will benefit the graduate students, whether they pursue a career in academia or industry. For the latter, we believe the Department can significantly improve its graduate students' preparation.

Another issue that we have noted is the lack of formal mentoring programs, and people who engage in mentoring activity do not get recognition for this important service. We have heard from graduate students that they have to resort to teaching each other how to use Canvas and other tools.

We were informed that substantial investment in grad level teaching training was done some years ago, including SVSPO training. With updates in technology and other teaching responsibilities, efforts should be made to ensure grad students are getting the on-boarding that is needed, so that they are not left to have to do the catching up themselves. Appropriate workload credit is also needed for leading on-boarding activities.

The Department should find out from instructors and TA's what they need to learn, and provide proper training. Any existing training seems to miss some key facets of their jobs. Mentors in these programs should be compensated as appropriate.

Our workshop coordinators and course instructors provide substantial training to our TAs. We are exploring additional avenues to enhance training. One idea is to let grad students shadow an instructor in a course, have them present some of the lectures, and participate in the preparation of assessments. TA training was also discussed in the recent Faculty of Science Strategic Planning sessions encouraging departments to collaborate on TA training.

***Recommendation 2.4**: Improve communication with graduate students.*

Communication was brought to us as an area that needs improvement. Some graduate students are left in the dark until the last minute regarding how many BU and how much research-related funding they will have for a given term. The late notification makes planning difficult. (See also comments above under graduate salaries and clarity about the (non)-reduction of stipends.)

Graduate students should be told what their supervisors have requested for them, in terms of teaching and funding, for the upcoming year, with the understanding that the request is contingent upon Faculty approval. This information can be incorporated into the grad progress report. There is an "Anticipated financial support for next year" box, where more term-by-term details can be stipulated.

Related topics raised by the graduate students included providing consistency, fairness, and transparency in other areas, including comprehensive exams, workload, and TA expectations. We encourage the department to engage in discussions on these topics, perhaps also consulting peers on their approaches for addressing the needs of today's graduate students.

Normally supervisors and their students discuss funding arrangements at the beginning of each year. Our Financial Assistant has implemented a better tracking system which we are now using, and we will improve the process where appropriate. Better communication is always good, but like with all communication efforts, they require recipients to do their share as well. As an example, a recent communication to graduate students regarding their TA duties included a link for students to confirm that they had read the information. Last spring 3 out of approximately 60 recipients confirmed, and this summer no-one did. Perhaps email does not qualify as effective communication.

We should add that we have redesigned our graduate student orientation event.

3. Undergraduate Teaching

Over the last several years the department has done an admirable job in navigating through the complexities of the pandemic, and even more substantially, the large increase in the number of students taking math courses. This has been in an environment of changing admissions and non-uniformity in high school standards, The department has innovated in a variety of ways to deal with logistical challenges, while working to focus to educational standards - e.g. efficient use of "mixers" to increase workshop/tutorial traffic, ID scanners for exams, options for joint majors, white board seminars as part of pedagogy, updates of Math for Life Sciences curriculum, etc.
Teaching and engagement of students is a high priority in the department.

At the same time there are critical structural challenges given the severe increases in student demands and lack of support for activities at the Surrey campus. Support of the Department to meet these challenges will be of great benefit to the students and the University overall.

Recommendation 3.1*: Change the structure of large first-year offerings*.

A number of people that we talked to have noted that the model of large lecture sections in service courses, supported by drop-in workshops, is no longer viable. Changes in provincial standards have created significant problems in first year courses. Students have difficulty transitioning from high school; this problem seems to have been exacerbated by COVID. With

increasingly poor student preparation, teaching faculty's workload has skyrocketed. Some instructors are recording lectures and using the classroom as practice and clarification time, but it is not clear that this is improving learning, nor is it a sensible solution for large classes. Leaving things as they currently stand will necessarily result in one of two undesirable outcomes: a high failure rate for students or a low competency level in students who pass. Staff also feel very overworked and the staff to AFTE ratio appears to be low compared to other units. (see also Section 4.)

The needs of undergrads with diverse backgrounds, becoming more acute with changes in provincial educational practices, require a number of changes in delivery of entry level courses.

- Placement exams can be used to stream students into appropriate courses, (e.g. foundational pre-calc courses (FAN) vs. calculus stream). See e.g. UBC placement exam system or other peer institutions.
- Required tutorials rather than optional workshops can be used to foster student learning and study skills.

Changes in these directions provides the opportunity to rethink the deployment of math TA's, who can be concentrated on the calculus stream, complemented with hiring undergraduate TA's and TA's from outside of math to support (FAN). The current "Calculus Connect" peer-learning program may be expanded. The Faculty and the Provost's Office should work with the Department to realize these steps, critical in support of the diverse student population and retention. It cannot be overemphasized that adequate resources to staff large service courses are critical. These courses are significant sources of revenue for the Faculty and need to be staffed accordingly. See also staff support for comments on administrative support for these programs (e.g. for educational IT and coordination support).

The reviewers give voice to many challenges and provide excellent suggestions. This is indeed a hugely complex issue. The department feels that, overall, we are highly efficient in delivering our courses with large enrollment while providing a high-quality learning experience for students. We are examining our workshop model, and there have been several pilot programs and changes to how we support student learning. Improvements will require resources. As a first step we would like to add a half-time admin position to support workshop operations. The "Calculus Connect" pilot program has been a success; we wish to continue with it.

Recommendation 3.2*: Update the computing requirements and integrate computing throughout course offerings.*

A research strength of the Department is computing, and this is also incorporated into the undergraduate curriculum. However, the current computing requirements were developed a long time ago. At present there are two Math programming language courses taught with a focus on Matlab and Maple, not the more popular language Python.

Many peer institutions have updated their curriculum as follows: ensuring programming literacy to be covered through a basic programming course in CS-type departments, with further computational experiential learning integrated directly in math courses through sample code and assignments in platforms appropriate to the subject - e.g. linear algebra

exercises in Matlab, R programming in probability/stats, symbolic computation in other areas, others for DE's, etc. This will require some updating of the courses. Minimal support through hiring of graduate or undergraduate TA's in summer would help to accelerate this modernization. *We emphasize that the undergrads we spoke to enthusiastically recommended (without any prompting from us) this modernization, which also included removing the existing platform-centric courses offered by the department and instead integrating computational techniques directly in courses. Further discussions with your math majors and undergrads would likely reveal other good ideas. They also had very practical recommendations about timing, accessibility, and alignment of various pre-reqs that have been barriers for getting to course sequences of interest.*

There may have been a misunderstanding. We do require our majors to take the first two computing (programming) courses at SFU, CMPT 120 in Python and CMPT 125 in C++. Additionally, we require our majors to take two 2 credit courses (one hour lecture, one hour lab), namely MACM 204 using Maple for Calculus and MACM 203 using Matlab for Linear Algebra. This is a stronger computing/math software requirement than most universities. The role of computing is being discussed in the department, and we want to change the level of integration of computation into our courses and move to open-source platforms where possible.

The department's Associate Chair for Undergraduate Learning routinely informs students about upcoming changes and has reached out for input from the students but received little or no response.

Recommendation 3.3*: Increase both the visibility and possible pathways to research and co-op type activities.*

The undergrads also indicated interest for increased opportunities in research and co-op type activities. In the present setting, there was little visibility or pathways

provided by the department/instructors/advisors for either of these activities: This could be improved by Advertising opportunities for USRA's or for co-op type experiences with the assistance of appropriate SFU offices. Modernizing courses to be relevant for co-ops will also be helpful - e.g. opportunities for projects that are valuable for applications.

We advertise USRA projects on the web site. This year the AWM chapter hosted an event showcasing our USRA projects.

Recommendation 3.4*: Develop a long-term strategy for Surrey.*

The Surrey campus was noted as an issue in the last review, and remains one this time. There may be two issues: one with the OR program that is run from Surrey, but for which most non-OR courses are taught in Burnaby; and the other with supporting the service teaching that takes place on the Surrey campus. Multiple faculty members brought up problems, including insufficient continuing instructors and TA support.
Sessional instructors are often hired, but there are concerns that they may not be able to develop the connections with students needed to advise them or to write recommendation letters. Also, most graduate students are not willing to commute to Surrey. They hold remote office hours, but that means there aren't enough local TA's to help proctor exams.

The Department and Faculty must decide whether they want to properly resource the Surrey courses, or just shut it down. The current approach of starving it does no one any good, long or short term. A potential approach is to hire a "pod" of teaching faculty to address the Surrey service courses, complementing the two that are already there. We emphasize that requiring some of the current teaching faculty to teach on both campuses is not a workable solution. We understand that the Surrey campus now offers 21 courses with a total enrollment of approximately 2,000 students. If there are worries about losing the 2,000 students, perhaps online courses can be an option albeit admittedly non-ideal.

SFU Surrey and our place there has been a contentious issue for some time. Mathematics started out with Surrey-based programs in Operations Research and three research faculty in that area with plans to increase to a group of five. After one faculty member left, the O.R. programs were moved to Burnaby in 2018, though some O.R. courses are still running in Surrey, which has to be fixed. We still have 3 research faculty though two of them now frequently teach in Burnaby. One Professor who works in Quantum Computing will likely move to Burnaby where most of their research connections are. Increasing the numbers of research faculty based in Surrey seems unlikely; we anticipate a move towards establishing a group of teaching faculty at the Surrey Campus to ensure consistent and high-quality delivery of our service courses there.

4. Administrative staff

The administrative staff that we met seem very capable and dedicated. The staff works as an amazing team, having an excellent rapport with each other and the department as a whole. Such a team is extremely valuable. They are eager to take leadership on needed activities, if given the support and time to do so.

However, a number of the staff expressed frustrations that they are overworked and not adequately appreciated and supported. They are also discouraged by the lack of attention or willingness to improve their work environment (e.g., poor temperature regulation in some admin offices). There also appears to be limited opportunity for professional development for staff members.

Recommendation 4.1*: Ensure appropriate workload and compensation.*

The department should better understand and recognize what each staff member has been doing. How much of that is outside of their job description? Some of the staff's job description may warrant a substantial update, and those roles subsequently upgraded. Ultimately, additional positions are likely needed because the Department seems to be understaffed and under-resourced relative to other units in the Faculty. What the staff see as critically needed is a new position with a portfolio that includes communications, event coordination, and alumni outreach. Alumni outreach seems to be relatively limited at the moment and there are fantastic opportunities to engage in outreach through high-profile activities like those of the Magpie group. Such outreach could also result in valuable contacts with industry.

Properly adjusting staff workload and compensation is important, because otherwise the department will need to prepare for many staff departures. Without good support staff, one cannot talk about providing a high-level of teaching or research. Department chair must follow up, and the Faculty Dean should ensure that administrators at the Faculty level support the Department in these requests. While beyond the scope of this review, the lack of attention to

staff was reported to permeate throughout the entire University.
It appeared that promoting professional development, career progress, and recognition for staff would go a long way in strengthening to overall environment

We also received data on the FTE support personnel in the Faculty, by department, together with the AFTE counts. The FTE support numbers in Math appeared remarkably low relative to their AFTE load. While it appears that some of the FTE support in other departments may be related to wet labs, nevertheless it appears that the scale of teaching labs in Math in the form of workshops and tutorials has not been supported at the same level, not to mention the sheer scale of administrative support needed to advise, instruct, and assess the students within Math's AFTE load. We urge the Faculty to assess and address these gaps in collaboration with the department.

The reviewers identified core challenges here, and we largely agree. There is, of course, little we (as a department) can do with respect to compensation levels, but we do remark, that current salaries barely exceed the living-wage threshold. We feel that the complexity of the department's operations justifies at least 1.5 additional administrative positions (one "Academic Coordinator", ½ workshop support), and we will formulate a proposal to the Dean and Provost.

Recommendation 4.2*: Provide professional development opportunities.*

Substantially increase the attention to the importance of staff and their contributions. Support via professional development is needed at all levels of administration. Give time off and funding support for staff to participate in professional development training.
Ensure clear guidelines for their job responsibilities, including both what is and what is not part of their workloads.

Professional development is supported by the department by giving time off when the training enhances skills required for the role. Funding for professional development is also available to staff via their respective Unions.

5. Work environment, EDI

We were pleased to see a very dedicated and engaged group of faculty, staff and students who care deeply about their colleagues, the Department, and its environment. The upcoming environment review by an external firm is also a step towards identifying future positive actions, and we encourage the department and Faculty to fully engage in that activity. That said, we note a number of workload issues that need to be considered in addressing workload balance throughout the department, with appropriate response measures formalized and made transparent.

Recommendation 5.1*: Address a number of workplace issues, as follows:*

- As noted above, many of the staff appear to be overworked.
- Also as previously noted, 20% of the math research faculty don't have an active grant. With no funding are they still mentoring graduate students? Is their teaching load the same as active research faculty? Are they taking on a larger administrative role?

- Teaching a small class or a large lecture with 500 students results in the same, one course, teaching credit.
- Teaching faculty can receive teaching reduction beyond going from 8 to 6 (i.e., going below 6) via additional initiatives. But what counts and how those additional teaching reductions are distributed isn't transparent to many members.
- Does merit review reflect important strategic contributions: for example but not limited to expansion of cross-disciplinary programs, pursuing new research funding avenues, major curriculum reform, other alignment with Institution/Faculty priorities
- Are the merit assessment criteria clear to all parties and followed?

Point 1: Agreed.

Point 2: This clearly is a topic of discussion for the department. Each faculty member gets a "one-course-equivalency" for being research-active, so that they only teach 3 courses per Academic Year. We need to come up with a good definition of "research-active", and criteria for when that label no longer applies. External funding would be one indicator, but our main objective is to assist faculty members in regaining grant support. Many faculty without a grant are actively supervising graduate students and continue to publish.

Point 3: When teaching a large class, the instructor has much support from workshop coordinators and the TA team. Teaching large classes poses many challenges, but it does not necessarily result in a significantly higher workload.

Point 4: Typically teaching equivalency credit is given for major curriculum or course development work.

Point 5 & 6: The salary review process may not be perfect, but TPCs and the Chair look at all aspects of a colleague's performance. Our RTP criteria – revised a year ago - are comprehensive and allow many forms of contributions to be taken into account.

Recommendation 5.2*: Provide resources to support EDI initiatives.*

We met with the EDI advisory group and the EDI learning group. One issue that stands out to us is that EDI groups aren't adequately supported in their activities. Staff contributions are considered uncompensated volunteer work.

To clarify: The reviewers met first with the EDI AG, and then jointly with the EDI Learning Group (EDI LG) and the Association for Women in Mathematics (AWM) Student Chapter. These groups have overlapping membership but different missions. The EDI Advisory Group (EDI AG) is a departmental committee that advises the Chair on policy. The EDI LG is a grassroots volunteer activity group aiming for self-education on EDI issues. The AWM is a student-run group that emphasizes gender issues and has organized many worthwhile Department-wide events. The Dean's office and the Department provided significant funding

to both the EDI LG and AWM — by contrast, no funding was available to other department seminars. The EDI LG might turn into a Faculty-wide group; if not, we are looking to merge the EDI LG and the EDI AG in some sensible way.

***Recommendation 5.3**: Ensure effective Faculty and Departmental EDI leadership.*

Department and Faculty leadership should demonstrate true support of EDI initiatives by providing resources and by their own in-person participation. EDI committee membership should have the confidence of department members who they represent.

Also, the fact that there is an EDI advisory group and an EDI learning group is odd, and is perhaps a symptom of underlying issues.

See the comment above.

Consider having the EDI advisory group led by two co-chairs. Leadership should have the support and buy-in of the faculty members. Perhaps then both EDI groups can be combined.

To improve the atmosphere in the department would require department leadership (possibly via an external hire) that is sufficiently free of baggage and capable of mending relations among faculty members. An excellent first step would be department-wide support of the EDI committee's ToR and their goals of facilitating integration of EDI goals in all department processes. Support from Faculty and University expertise should be sought regularly in realizing these goals. Success and expertise at peer institutions provide many good examples which can be adapted. Take the upcoming external environmental review seriously, and work with them to get the most out of their interactions from the department.

The EDI Advisory Group ToR have been discussed extensively in the EDI AG and the Chair's Advisory Group, and after several revisions will be brought to the department for further discussion and approval within the next few months. The environmental scan is underway, and assessments and recommendations are expected by the end of summer or beginning of fall.

Active involvement at both the institution and Faculty levels will also be essential for success. As new strategic plans are put into place, EDI must be articulated as a necessary ingredient in excellence throughout all programs, not as an "add-on" at the end. Concrete actions that demonstrate this should appear at all levels.

The Faculty should commit to working actively with all departments to ensure visible and robust EDI processes that are embedded in recruitment, retention, and realizing an inclusive workplace.

SFU SIMON FRASER UNIVERSITY

Educational Goals Assessment Plan

Unit/Program: Mathematics

Contact name: JF Williams

Date: July 10, 2023, modified September 13, 2023

This template is designed to help units implement assessment of Educational Goals after receiving feedback from their External Review. Units are not expected to assess every Educational Goal every year. *(Textboxes will expand as you type)*

1) **Who were the members of your Educational Goals Assessment team?** Outline who has worked on the assessment.

The Math UCCs 2019-2023 with additional contributions, large and small, by P. Menz, N. Nigam, R. Fetecau, J. Niezen, K. Honings, D. Muraki, JF Williams, J. Mulholland, and M. Trummer.

2) **Are your program's Educational Goals current, or do any of them need to be revised?**
In some cases, Educational Goals may need to be revised to keep apace with changes in the discipline or in the program's course offerings, or to ensure they continue to align with a unit's mission and values. Feedback from the External Review may inform revision of Educational Goals.

The highest-level educational goals are complete. We are in the process of refining and adding the core competencies which make up each goal. The current goals are aligned with various themes:

1) **Mathematical Problem Solving** Students will develop a wide base of knowledge of mathematical notation, concepts and techniques from areas including calculus, algebra, discrete mathematics and computation. They will apply this knowledge and these skills to formulate and solve quantitative problems.
2) **Mathematical Reasoning** Students will learn the importance of rigour in mathematical reasoning and understand the role of notation, axioms and definitions. They will demonstrate the difference between an argument and a proof and apply definitions, formulate arguments, and construct proofs using techniques appropriate to the area.
3) **Mathematical Modelling** Students will develop the ability to use mathematical concepts and techniques to formulate and solve problems and interpret the results in context. These problems will be drawn from a variety of fields which may include physics, engineering, data science, computing science, and the life and social sciences.

4) **Mathematical Computation** Students will use computer software and programming languages as a thinking tool to learn, do and explore mathematics. They will analyze, implement and use core mathematical algorithms. They will formulate, simulate and analyze mathematical problems in a structured, logical, scientific manner computationally.
5) **Mathematical Communication** Students will develop the ability to communicate mathematical ideas verbally, graphically and in writing to a diverse range of audiences.
6) **Professional Collaboration** Students will develop the ability to work independently and in teams on mathematical problems. They will respectfully express and refine their ideas working with their peers to learn and present their work.

This is a rephrasing of our previous goals.

Math students are able to:

- solve mathematical problems with mathematical techniques
- state and prove theorems
- model real world problems
- use mathematical software
- communicate effectively
- work in teams

Our new statements include more details but are still directed towards employers, parents and potential students and do not contain all necessary details for evaluation.

3) Is your program's curriculum map up to date?

A curriculum map may need to be updated to reflect any major changes to the program's course offerings (i.e. new or substantially revised courses, courses that have been removed).

No. We are reworking our curriculum map based on changes in the computational aspects of our curriculum identified during the external review, the addition of a new Bio-Math concentration and the ongoing development of core competencies that relate to each of our Educational Goals.

4) Assessment Plan

For each Educational Goal, outline what data you will use to assess student learning. Indicate what direct evidence you will draw on - which key courses you will sample from and, if possible, the course-based assessments you plan to use. These can be described in general terms (e.g. research paper, final exam questions targeting a particular Educational Goal). Indicate also whether or not you plan to gather indirect evidence (e.g. surveys, focus groups, interviews, etc.). The same indirect evidence method (e.g. a survey) can be used for multiple Educational Goals. Describe what would indicate to you that students had met the Educational Goal. Add or delete rows as needed.

Educational Goal 1: **Mathematical Problem Solving** This goal contains the foundational elements of calculational mathematical skills required for all classes.			
Description of Assessment Methods: **1)** We will survey instructors in a sampling of first and second year classes to summarize the strengths and weaknesses in the students when performing basic calculations. **2)** We will sample a selection of exams from a selection of classes to verify that, by this stage MATH majors are proficient in basic calculation techniques in these areas.	**What would indicate that students had met the EG?** The breadth aspect of this goal is met by the construction of our program requirements. Proficiency in the skills comprising this goal is necessary for success in all areas. The results of the surveys from first and second year classes will help us identify if any specific skills (curve sketching, algebraic manipulation, etc.) need particular attention for future course modifications.	**Is this direct or indirect?** Direct.	**When do you plan to collect the data?** 2023, 2025, 2027, 2029
Educational Goal 2: **Mathematical Reasoning** This goal contains the foundational elements of abstract mathematical thought mathematical skills required for all classes.			
Recent surveys of the instructors of 201, 240 and 242 have led us to introduce a new class on mathematical proof. How and when we assess these skills may change based on what happens with that class. **Description of Assessment Methods:** We will assess classes in the analysis, discrete math, algebra and applied math streams separately by having groups of 3-4 instructors sample final exams from the most advanced classes in each stream and assess them based on goal specific rubrics (NOT the solution key used during the course grading) currently being developed.	**What would indicate that students had met the EG?** All students that pass any of 314, 320, 322 and 340 will have met this EG and all our programs require some of these classes. The question is how many to what standard of performance in each of the streams and where we can make small adjustments.	**Is this direct or indirect?** Direct	**When do you plan to collect the data?** 2026, 2029.
Educational Goal 3: **Mathematical Modelling** Assessing competence in this area requires considering both the process (how modeling is done) and the outcome (how successful models are).			
Description of Assessment Methods: **1)** Random samples of work a selection of upper divisions classes.	**What would indicate that students had met the EG?**	**Is this direct or indirect?**	**When do you plan to collect the data?**

2) Faculty surveys and analysis of transcript data to see who is taking what classes to get a better sense of the breadth of exposure of students to models in different fields.	Students' demonstrated ability to build mathematical models in different fields using different types of mathematics.	**Both.**	**2024, 2027, 2030**
Educational Goal 4: **Mathematical Computation** Teaching related to this goal is currently being redone from the ground up.			
Description of Assessment Methods: We are in the process of surveying faculty, students and co-op employers about this area. Our intention is to rebuild our introductory mathematical computing classes and then add more in-class computing activities across more classes. It will be 2-3 years before this transition is complete and any sensible assessment can be done. At that point we will proceed with sampled assessments and student and faculty surveys.	**What would indicate that students had met the EG?** Fluency in at least one computing language to perform mathematical computations as well as expertise in at least one piece of mathematical software. Students should be so comfortable using software that is simply a thinking tool, like a pencil and paper.	**Is this direct or indirect?** **Both**	**When do you plan to collect the data?** **2026, 2029** **Or 2027 and 2030**
Educational Goal 5: **Mathematical Communication** This goal will be revisted once we have re-certified (or not) our existing W-classes.			
Description of Assessment Methods: 1) Random sampling of items (assignments and projects) from a selection of W-certified classes for writing content as these are all our currently W-labelled classes. 2) Faculty surveys regarding student proficiency for visualization from the above and additional computational. 3) Currently only our Honors students reliably take classes with oral presentations. We are looking for places to expand this and then will survey those classes as well.	**What would indicate that students had met the EG?** We will revisit this question once we have re-certified W-classes and have a better idea how they will work. We currently have a considerable amount of group work activities in many of these classes that will need to be redeveloped.	**Is this direct or indirect?** **Both**	**When do you plan to collect the data?** **2025, 2028**
Educational Goal 6: **Professional Collaboration** This not a formal component of any classes but is common to many individual instructors when they teach certain classes. This goal is currently met reliably only in some degree streams.			

Description of Assessment Methods:	What would indicate that students had met the EG?	Is this direct or indirect?	When do you plan to collect the data?
1) Faculty surveys to identify who does collaborative work and in what classes. 2) Student surveys	Initially we will look to determine how many classes students typically take where they work in teams and what additional opportunities, like team-based peer mentoring, they take advantage of.	**indirect**	**2023, 2026**

5) How do you plan on sharing your findings within your unit?

All results will be shared with all members of the department at department meetings and the reports archived on the internal server.

6) Assessment Timeline

Next Mid-cycle Review: 2027

Next External Review: 2030

SFU OFFICE OF THE VICE-PROVOST, LEARNING & TEACHING

Strand Hall 3034
8888 University Drive
Burnaby B.C. Canada V5A 1S6

TEL + 1 778 782 5433
avplt@sfu.ca
SFU.CA/vpacademic/learnteach

MEMORANDUM

ATTENTION:	Department of Mathematics; SCUP; Senate
FROM:	Elizabeth Elle, Vice-Provost, Learning & Teaching
RE:	Action Plan for Educational Goals associated with 2023 External Review of Math
DATE:	26 July 2023

The Department of Mathematics has recently undergone an external review. As per our practice, in addition to developing an Action Plan connected to the specific recommendations of the external review team, the Department has developed a plan for moving forward with assessment of their educational goals.

The review has recommended some attention be paid to the large, service courses that Mathematics teaches to first year students, as well as to improving the computational aspects of the Math curriculum. Both of these items will impact the work planned for Educational Goals. The large service teaching component for the unit can be especially challenging to contemplate, as EGs are normally identified for program (major) students. In this regard, the department has well defined EGs that they are working to refine by adding core competencies, and acknowledge that a curriculum map should wait until some of this work, along with adding more computational aspects to the curriculum, is complete.

The assessment plan is ambitious and not very well defined in terms of timing. My strongest recommendation is that the Math department consider what they might most want to know about their upcoming changes to curriculum, and choose only a few of the EGs to focus on between now and their midcycle review in 2027. Doing so will provide more purpose to the work and make it more tractable than the current suggestion that everything will be measured in a very large number of courses (choose fewer courses, too!).

Second, consider whether your current plan is the best way forward to gain better understanding while protecting faculty time. It appears from your assessment plan that you will ask a number of faculty to re-assess a component of student work in the context of your EGs. Is there no way to use existing assessments within a course, intentionally linked to a specific core competency, to gather the information you are interested in? Combined with your planned survey work you may gain enough useful information from this approach as you refine your curriculum.

Finally, some of the work in your assessment plan is really about building your curriculum map (group work, computing activities, communication (writing and presentation) skills. For these areas of interest, I do encourage you to complete the background work before making the changes in your curriculum that are currently contemplated in your assessment plan.

Thank you for all you do to support undergraduate learning in the Department of Mathematics.

ESS Memo and **Department Response**

The Department of Mathematics has recently undergone an external review. As per our practice, in addition to developing an Action Plan connected to the specific recommendations of the external review team, the Department has developed a plan for moving forward with assessment of their educational goals.

The review has recommended some attention be paid to the large, service courses that Mathematics teaches to first year students, as well as to improving the computational aspects of the Math curriculum. Both of these items will impact the work planned for Educational Goals. The large service teaching component for the unit can be especially challenging to contemplate, as EGs are normally identified for program (major) students. In this regard, the department has well defined EGs that they are working to refine by adding core competencies, and acknowledge that a curriculum map should wait until some of this work, along with adding more computational aspects to the curriculum, is complete.

The assessment plan is ambitious and not very well defined in terms of timing. My strongest recommendation is that the Math department consider what they might most want to know about their upcoming changes to curriculum, and choose only a few of the EGs to focus on between now and their midcycle review in 2027. Doing so will provide more purpose to the work and make it more tractable than the current suggestion that everything will be measured in a very large number of courses (choose fewer courses, too!).

We have reduced the scope of our initial investigations. We had included a long list of classes as we have very few upper division requirements and need broad coverage to properly assess all students. We will work with IRP to identify those classes that would give us good coverage of both students and mathematical areas.

Second, consider whether your current plan is the best way forward to gain better understanding while protecting faculty time. It appears from your assessment plan that you will ask a number of faculty to re-assess a component of student work in the context of your EGs. Is there no way to use existing assessments within a course, intentionally linked to a specific core competency, to gather the information you are interested in? Combined with your planned survey work you may gain enough useful information from this approach as you refine your curriculum.

We disagree slightly here. There is a very wide gap between the content assessed on any exam question and our high-level educational goals. We believe that the only way to bridge that gap is to have instructors make these assessments directly. We will of course be mindful of faculty time and will reduce the number of classes in which to undertake this assessment.

Finally, some of the work in your assessment plan is really about building your curriculum map (group work, computing activities, communication (writing and presentation) skills. For these areas of interest, I do encourage you to complete the background work before making the changes in your curriculum that are currently contemplated in your assessment plan.

We agree that we may have been overly ambitious. We will adjust the timeline for some of our assessments after two years when we have had a chance to see how much work is truly involved.

Thank you for all you do to support undergraduate learning in the Department of Mathematics.

Jfw/mrt September 13, 2023